

Laser Angioplasty

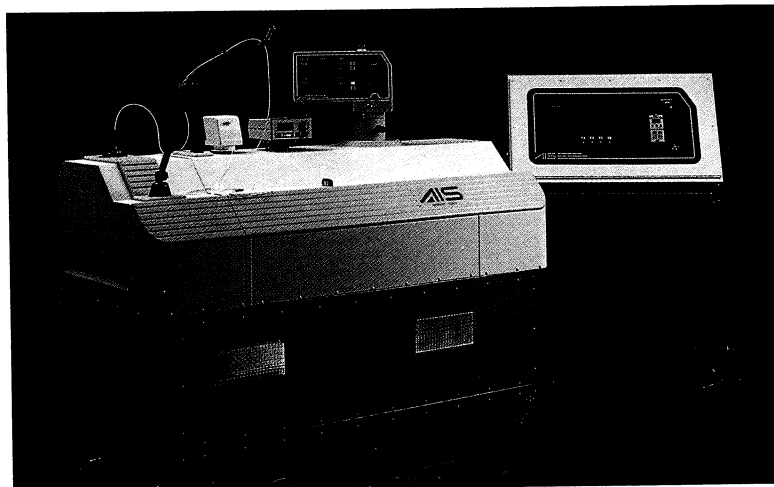
Atherosclerosis is the buildup of fatty deposits—called plaque—in human arteries. In time the plaque partially or totally obstructs the flow of blood through the clogged artery and threatens life. For example, extreme blockage of a coronary artery, which carries blood to and from the heart, can result in a heart attack and death.

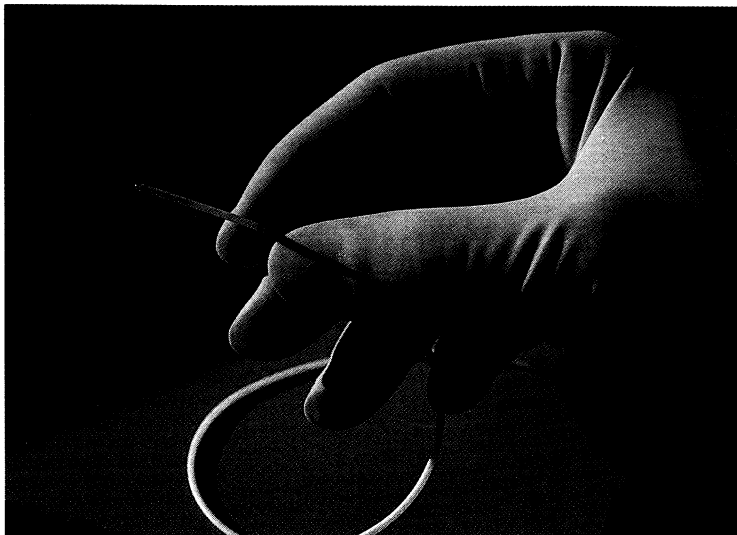
The principal method of dealing with coronary artery blockage is bypass surgery, in which clogged blood vessels are replaced—a high cost procedure with some risk. A non-surgical alternative available to some patients is balloon angioplasty, in which a flexible catheter with a tiny balloon at its tip is worked into the blocked artery; inflation of the balloon pushes aside the plaque and widens the artery for improved blood flow.

For several years, medical researchers have been exploring another alternative that would help a wider circle of patients than the balloon treatment and entail less risk than bypass surgery: laser angioplasty, in which a laser inserted in a catheter vaporizes the plaque and thus opens the artery. Several types of lasers have been employed in tests on human cadaver and animal arteries. The problem has been that the lasers are too hot. Human tissue can withstand heat up to 154 degrees Fahrenheit; most lasers heat tissue to much higher temperatures, which can cause damage to arterial walls.

Now, however, a research group is on the verge of an exciting development: laser angioplasty with a “cool” type of laser—called an excimer laser—that does not damage blood vessel walls and offers non-surgical cleansing of clogged arteries with extraordinary precision.

The system is the Dyrmer 200+ Excimer Laser Angioplasty System (top), developed and produced by Advanced Interventional Systems, Inc. (AIS), Irvine, California. The Dyrmer 200+ is based on NASA-patented technology developed at Jet Propulsion Laboratory (JPL) for satellite-based atmospheric studies. AIS' top management includes the two former JPL scientists who invented the excimer laser to measure gases in Earth's atmosphere: Dr. James Laudenslager,





AIS' vice president—laser development, and Dr. Thomas Pacala. The JPL laser research team also invented a magnetic switching system that is incorporated in the Dyrmer 200+.

Development of the system began in 1984 when physicians Drs. Frank Litvack, James Forrester and Warren Grundfest started to explore the possibility of using lasers to unclog arteries and went looking for a laser that could do the job without damaging vessels. They recruited Drs. Laudenslager and Pacala, and Dr. Tsvi Goldenberg, a fiber optics researcher at AT&T Bell Laboratories. With funding from NASA, the National Institutes of Health and private donations, the group developed the laser angioplasty system and then, having obtained a NASA exclusive license for the JPL laser technology, founded AIS to commercialize it.

Used in human clinical tests since 1987, the Dyrmer 200+ system is the first fully integrated "cool" laser capable of generating the requisite laser energy and delivering the energy to target arteries—either coronary arteries or peripheral arteries in other parts of the body. With the JPL-

developed technology of magnetic switches, the excimer laser can be made to produce a uniform beam of energy that can be controlled and pulsed in a period as little as 200 billionths of a second. This is longer than most commercial excimer lasers, whose pulse widths are 25 billionths of a second; the system's so-called "stretched" pulse width allows the pulses to propagate through fiber optics.

At far left, Dr. Kenneth Kent and his nurse prepare for laser angioplasty at Georgetown University Hospital, Washington, D.C.; they will monitor the procedure on the video screens above the operating table. In the lower left photo, the physician inserts a flexible catheter into an artery in the groin, then threads it into the blocked coronary artery; a closeup of the catheter is shown at left center.

The laser light source is carried through multiple fiber optic bundles within the catheter. This AIS-patented fiber optic delivery system was developed by Dr. Goldenberg.

Watching the video, the physician spots the area of plaque buildup and vaporizes it by firing short bursts of the excimer laser. It happens so quickly that neighboring tissue is spared from damage. In the top left photo is a before laser-use x-ray image in which the arterial blockage is evident in the narrowed segment of the artery (arrow); at top right is an after-laser view, blockage removed.

Thirteen research hospitals in the U.S. have purchased Dyrmer 200+ systems and have used them in clinical trials in 121 peripheral and 555 coronary artery cases. The success rate in opening blocked coronary arteries is 85 percent and there have been comparable or fewer complications than in balloon angioplasty. AIS hopes to get Food and Drug Administration approval for general marketing of the system in the latter part of 1990.